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Introduction

This report is an excerpt from Deliverable D1.4.1.3 of EU Project iNTeg-Risk. The model presented here is the result of Task 1.4.1 of the iNTeg-Risk project that addressed safety problems related to outsourcing and subcontracting of safety-critical tasks. Concerns have been raised over the effects of the fragmentation of work processes associated with subcontracting and outsourcing, where safety may be affected by heterogeneous safety cultures, distributed lines of responsibility, unclear ownership of safety responsibility, and sometimes lack of local knowledge or lack of core skills.

The model has been elaborated by the authors with invaluable input from our iNTeg-Risk partners, in particular:

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1. Market and network

This category concerns the general population of organizations (clients and contractors), the non-contractual relations between organizations, and the process of selecting contractors.

In this process, the *Client* specifies the requirements for the expected result in a tender, while describing the conditions under which it is to be delivered. When using the market, the client accepts that use of resources in principle becomes a 'black box': the client no longer controls the resources directly, but relies on market competition – comparing prices from several bidders – to reduce costs, and thus optimize benefit from resources. This is the basic characteristics of using the 'market' as opposed to the internal or 'hierarchical' solution ('buy' vs. 'make').

Potential *contractors* then make bids for the contract, describing how they will perform the task, and how much it will cost. In principle, they need not specify exactly *how* work is carried out, only how their operations will affect (and depend on) others, e.g. client employees or other contractors. The customer is interested in the final result and often avoids concern with the details of execution.

Preparing a bid is associated with some degree of uncertainty: a contractor runs a risk when drafting the work. If the contractor ends up spending fewer resources than planned, he will earn the difference (with a "fixed price" contract). If, on the other hand, he spends more resources than planned, costs will not be covered by the agreed price, resulting in a loss for the contractor – unless they represent additional costs due to unforeseen events or new requirements from the client and may thus be negotiated between the contract parties.

A contract may require *dedicated* resources (asset specificity), e.g. specialized equipment or staff that are only used, but not exhausted, for this task, and they constitute a special economic challenge to the contractor – and to the contract. The contractor may either let the client cover the full investment for this contract, increasing the price for the client, or look for other contracts to utilize the resources, with the same client or other clients with similar needs.

Furthermore, the bidding process and the bid itself represent an uncertain investment by the contractor – it will only be reimbursed if that contractor wins the contract. Extensive preparations for many uncertain contracts will be a high cost for a contractor.

While selection of contractor here has been described formally as an open market, it may also rely on tighter relations between specific companies allowing smooth exchange of knowledge and mutual adaptation of safety procedures etc., though at the risk of excluding potentially competitive contractors.

Basically, contracting of a safety-critical task can be undermined by two fundamental 'flaws' in the process of selection: inadequate dedication of resources to safety in the overall design of the work to be performed ('inadequate safety budget') (problem 1.1); and/or use of a contractor with inadequate safety qualifications or safety culture (problem 1.2).

Problem 1.1.Unsafe bids

Client selects bids with minimal budgets and inadequate safety measures. Safety will often require dedicated resources: e.g. safety equipment, qualified staff and safe work processes that tend to be more

time-consuming. If costs associated with such safety measures are not agreed in the contract, safety precautions during execution of work will represent delays and additional costs and may be 'suppressed'. If, for instance, a client does specify rigid safety measures, but only *after* agreement on contract and price, these measures may require additional costs for the contractor, who will then be disinclined to comply.

Problems with inadequate safety budgets may occur because safety measures are not included in bids from the contractors, e.g. due to inadequate preparations, or due to insufficient information about conditions from the client. Or the problem arises because the client selects a bid with inadequate safety measures, e.g. because he focuses exclusively on the price. It may also be difficult for either part to document the benefits associated with safety costs.

This problem is focused on the link between safety measures and dedication of resources, e.g. in the availability of equipment and adequate time to perform the tasks safely within agreed deadlines. Problems associated with more detailed planning are treated in section 3.

Various solutions can be implemented to ensure awareness of safety and the need to include adequate safety measures in the work to be performed by contractors: the bids should include safety measures from the start; above-average safety measures should be rewarded in comparison with other competitors; and safety costs should be protected from competition.

Solution 1.1.1 Client should require bids to include safety measures

Both client and contractor should strive to ensure that bids take into account adequate safety measures. The client should thus specify (in the tender): Safety-challenging conditions – conditions that require extra precautions, as well as specific safety rules and precautions expected for the work, in order for the contractor to include associated costs in the bid.

Contractor should document that their bids – and the budgets – allow for an adequate level of safety, documenting the use of relevant safety equipment, qualified staff and a reasonable timeframe etc.

This solution primarily emphasizes the general dedication of resources to safety, while more detailed plans for safe execution are specified later, and general measures implied in the contractor's safety organization are treated in relation to problem 1.2. Smaller jobs, in particular, should not require detailed planning in advance – in this case, it is more important to be sure that the contractor has the necessary qualifications.

Challenges to this solution

Very specific safety requirements in the tender may discourage many contractors who feel that an 'honest' budget will be costly and not competitive in comparison with other contractors less concerned about safety precautions – leaving the client with a limited pool of less sincere bids. Detailed requirements may also put unnecessary restrictions on a contractor who may be able to find safe solutions with other means.

Specifying safety measures may require a highly detailed bid by the contractor, in which case bidding thus represents a large, uncertain investment for that contractor – and, in the end, higher prices for the client and larger costs associated with contract management.

Solution 1.1.2 Client should reward above-average safety benefits

This will allow a potential contractor to improve its chances in the competition by offering better safety, not simply by keeping price at a minimum – and thus encourage contractors to make an extra effort for safety. This will improve the effects of the previous solution (1.1.1), which might otherwise allow competition to drive all bids towards an 'acceptable' minimum level of safety.

This will require a 'best-bid' approach as opposed to 'best price', and the client must specify criteria for awarding safety initiatives.

Challenges to this solution

The 'best-bid' approach may constitute a specific challenge to public institutions that are normally required to follow EU regulations specifying that they choose the cheapest solution. However, it is also possible to use the EU 'model 2' allowing a client to choose 'best value for money'.

A client may already use the 'best bid' approach – or EU 'model 2' – for other purposes than safety, e.g. quality and timeliness. If this approach is *also* used to emphasize safety, safety may be over-shadowed by other criteria.

This solution requires documentation of safety benefits, which may be difficult to assess and measure.

Solution 1.1.3 Remove safety costs from the competitive element of the bid

Costs associated with safety measures in the bid should be excluded from competition – and thus protected from efforts to reduce price and minimize costs. Safety measures should be specified – and negotiated – only after contract has been agreed, and the client should pay the associated costs.

This solution – removing safety from competition – thus differs from solution 1.1.1, which required specification of safety costs 'up front', while it is the *opposite* of the solution 1.1.2, which aims at *promoting* safety in the competition.

Challenges to this solution

Safety-related measures should be protected from a competition merely focused on cost-saving, but *not* from critical assessment. Safety investments have a tendency to be 'boundless': there will always be additional measures available that will improve safety, at an increasing cost. When specification of safety costs have been removed from the market mechanism, a contractor may be tempted to be over-cautious, as long as these costs are reimbursed directly from the client. The client will therefore need a critical assessment of proposed safety measures – to keep these costs under control (see above, 1.1.2).

Postponing negotiation of safety costs may put either part at a disadvantage, e.g. a contractor may find it difficult to convince the client of the necessity of further investments (delays etc.); or the client may no longer be able to 'enforce' specific safety measures (safety rules etc.), once the contract has been agreed.

Safety may be an integrated element, and associated costs thus difficult to separate from the main aspects of the job.

Problem 1.2 Unsafe contractors

In some cases, the client may rely more on the general safety qualifications of a contractor than on his specifications for the job.

Selection among bids may thus also fail, if the selected contractor does not have the adequate qualifications required to perform the job safely, or, despite of well-documented formal safety qualifications, does not have an adequate safety culture, i.e. proper regard of the risks associated with the job and appropriate respect of relevant safety rules.

This is not only a problem of a client selecting an unsuitable contractor. It may also be a problem for a contractor that has not been aware of safety implications of a contract.

The risk of a mismatch between contractor and task/client may be reduced, partly by filtering out companies with inadequate safety qualifications or 'attitude', partly by giving priority to companies with good safety performance. Screening out unsuitable contractors is often done in a 'prequalification' phase, which is less suited to reward 'good' performers.

A contractor's safety performance can be assessed by different means: quantitative indicators (1.2.1), 3rd party certification (1.2.2), the client's experience from previous contracts (1.2.3), or own SMS (1.2.4).

Solution 1.2.1 Quantitative safety indicators

A contractor's safety performance can be indicated by various quantitative indicators to supplement his own formal documentation.

Known indicators thus include: Sickness absenteeism and turnover; Experience Modification Ratings; Incident Rate; Qualifications of safety personnel.

Challenges to this solution

Many indicators are easily manipulated, and they only measure past performance.

Solution 1.2.2 Third party safety certification etc. of contractors

A client can rely on a 3rd party to assess and certify potential contractors, possibly based on industry standards established in cooperation with similar companies sharing the costs of assessment, monitoring etc. 3rd party could be another company, an association, or even a public authority, if a client can rely on regulatory oversight in certain industries. The 3rd party should also monitor and check companies, and revoke the approval if necessary.

Such 'shared' certification may also be a more economical solution for contractors who will thus reduce the redundant efforts of providing similar documentation for different clients – and only be required to document once for the 'certifying' company.

Challenges to this solution

Monitoring/checking small companies may be very costly, as it takes time to visit several companies (problem 4.2). Companies working on multiple 'foreign' work sites are more costly to monitor (e.g. construction workers moving from one construction site to another).

This solution requires a well-defined domain/area of expertise, shared by other companies – and will be difficult for a unique and highly specialized company.

Solution 1.2.3 Experience from previous contracts

Rather than relying on quantitative indicators of questionable validity, a client can use the 'deeper' knowledge gained from previous contracts. Re-using contractors also gives an opportunity to specify further requirements or possibly mutual adjustments, e.g. by letting problems or incidents during one project be used for improvement and learning, rather than formal rewards and penalties in the contract.

This solution can be structured as a list of preferred contractors. Where the previous solution requires a 3rd party to explicitly monitor a contractor at various occasions, this list will be informed by the client's own experience from specific contracts.

Such lists also have a further potential for building stronger long-term relations, e.g. by taking care of trusted companies to keep them competitive and avoid 'grey market' companies. And they may allow a contractor to invest in safety equipment and qualified staff in reasonable expectation of future contracts – investments that would otherwise constitute an economic risk.

Challenges to this solution

Blacklisting or preferring particular contractors inhibits free markets and may exclude potentially useful contractors, increase dependency on particular contractors and inhibit (cost-saving) price mechanisms.

Public clients subject to EU 'regulation' are not allowed to favor 'preferred contractors'.

Solution 1.2.4 Safety Management System

Contractors should document that they have their own SMS, in which case they can be entrusted with larger responsibility for workers and safety planning.

2. Contractual relations

This category concerns issues related to the contractual framework that is defined, once a contractor has been selected. Problems can arise from specific formal requirements laying out the economic framework of the contract. Elements in the contract determine the economic interests of the contractor (and the client) and will thus shape their behavior in the daily work.

The contract is designed to mediate conflicting interests between the two parties of a contract, and there are two basic models. 1) Price and deadline are agreed from the start ('lump-sum' contract): the contractor will have a direct economic interest in meeting deadlines, since he has assumed the economic risks associated with his original bid and may be required to pay for delays. An optimistic bid or unforeseen changes will put the contractor in dilemmas balancing safety against economic loss. 2) Costs covered by the client: the contractor will be less concerned about minimizing costs, while the client will have a stronger interest in monitoring the use of resources. Contracts may be variations of the two 'extremes': some costs may be covered by the client, and adjustments adapting to changing (external) conditions may be covered by the client or renegotiated (as implied in solution 1.1.3).

In particular, there may be problems associated with short-term contracts (2.1), incentive schemes (2.2) and subcontracting/cascading contracts (2.3).

Problem 2.1 Short-term contracts

Short-term contracts may not motivate contractors to make safety investments (equipment, training) that are only relevant for the current contract. They thus accentuate the problem of asset specificity (see earlier).

While this is an economic risk for the contractor rather than the client, the client should be concerned about the economic dilemmas faced by a contractor, who will not be motivated to invest in the most updated equipment, or in extensive maintenance. This is especially a problem for *smaller* contractors with few clients (with the same needs).

If, on the other hand, the contractor succeeds in using resources for other contracts/projects, they become a critical/limiting resource and may not be readily available.

Also, short-term contracts will leave a contractor with inadequate time to familiarize with the conditions of a workplace.

This problem can be addressed by either preferring long-term contracts (2.1.1) or by promising a contractor more contracts in the future (2.1.2), or reduce cost of general safety training and equipment (2.1.3).

Solution 2.1.1 Prefer long-term contracts

The client should prefer long-term contracts. If this is not possible for one client, the same contractor may be shared within a consortium of clients, thus enabling a contract for a longer period. This will allow the contractor to invest in specialized resources – and reserve them for the current project.

Challenges to this solution

It may not be possible for a single client.

Solution 2.1.2 Promise future contracts

The expectation of future contracts, e.g. by being included in a list of preferred contractors (solution 1.2.2), can motivate the contractor to make extra investments in safety. A –reasonable– expectation of future contracts will thus compensate for short-term contracts.

This solution has the advantage over the previous one of allowing the client to 'test' a contractor during a short contract, and only then approve the contractor for long-term projects. The 'promise' will thus be conditioned on 'safe behaviour' during the first contract and is strongly related to solution 1.2.3.

Challenges to this solution

Such promise of future contracts will inhibit the market mechanisms for those contracts and make it more difficult to look for better options, since it excludes potential alternative contractors.

Not possible for public companies subject to EU regulation (see earlier).

Solution 2.1.3 Reduce costs of general safety training and equipment

The client can reduce the safety investments required by the contractor by making training and equipment available at a lower cost. The costs of general occupational health and safety (OHS) training can be reduced, e.g. by including it as part of the technical training, and safety equipment can be offered to contractors at a favorable price.

Problem 2.2 Incentive schemes

Payment to contractors is normally based on results rather than on actual expenses, and the client will seek to encourage deliveries promised in the bid and ensure (timely) contractor output by establishing rewards and penalties based on output measures (e.g. deadlines met).

Such rewards and penalties *enforce* the conditions of the contract and may be necessary for a client facing a contractor with other interests and priorities, e.g. when judging deadlines less important than a need to spend critical resources for other projects. Rewards may also be used to encourage the contractor to perform better than planned, e.g. to finish sooner.

Such measures transfer economic risk to the contractor. In situations with unforeseen delays and costs the pressure to fulfill the contract can motivate contractors to sacrifice safety – especially if they perceive the risk of economic loss as greater as or more immediate than the risk to safety.

Strict output measures may also motivate the individual contractor to focus narrowly on his own contribution, rather than on the process or project as a whole, which may lead to problems with coordination of work. This problem is critical for team production where tasks performed by the contractor are highly interdependent on those performed by the client or other contractors.

This problem can be addressed by various solutions: by protecting safety-critical tasks from performance pressure (2.2.1); counterbalancing with incentives based on safety indicators (2.2.2); or implementing 'holistic' safety incentives (2.2.3).

Solution 2.2.1 Reduce/avoid performance pressure on safety-critical tasks

Output measures and incentives are avoided for safety-critical tasks – or at least modified to allow for open communication about exceptional and unforeseen conditions. This solution corresponds to solution 1.1.3 (removing OHS from competition) and require the identification of a separate safety 'domain' that can be protected from competition or performance pressure.

Challenges to this solution

It may be difficult to separate safety-critical elements from other tasks/elements.

There is a risk that such a 'protection zone' simply transfers pressure to other tasks – that may then become safety-critical.

Solution 2.2.2 Complementary safety indicators

The client should counter-balance performance pressure by complementary indicators for safety as part of the contract, at least to make visible possible safety costs of high productivity.

Safety indicators may further be linked to incentives matching those for productivity, e.g. rewards for good safety actions and/or for achieving a high level of safety.

This solution can be compared to 1.2.1 (quantitative safety indicators) and especially to 1.1.2, when previous safety performance is rewarded in the bidding process.

Challenges to this solution

Rewards and penalties associated with safety indicators sometimes have unintended effects, contractors becoming focused on specific indicators, while disregarding other safety concerns. Penalties in particular tend to become counter-productive and will encourage manipulation of indicators and prevent openness about safety issues, e.g. by hiding information about incidents.

Solution 2.2.3 Collective safety incentives

Introduce incentives that encourage responsibility for the safety of a worksite or a project as a whole – rather than basing payments solely on the contractor's individual task. This will encourage contractors to consider wider safety consequences of their actions – rather than focusing too narrowly on their own task, sometimes with disastrous consequences for others. This solution can be regarded as a special case of the incentives mentioned under solution 2.2.2, but it emphasizes safety aspects that go beyond the individual contractor.

Challenges to this solution

Should not be confused with p*roduction*-oriented collective incentives that are widely employed for other goals than safety, e.g. by encouraging 'ownership' of a construction project as a whole by rewarding subcontractors for completing the project before time – incentives that may have negative implications for safety.

Collective' safety incentives, e.g. a shared bonus for 'no injuries during project', are often counter-productive, especially when it is difficult for an individual party to adjust behavior and affect the collective result significantly – in other ways than manipulating indicators.

Problem 2.3 Subcontracting (cascading contracts)

Several layers of contracting (pyramidal or cascading contracts) may further blur responsibility for safety.

This problem can by avoiding cascading contracts (2.4.1), specifying responsibilities (2.4.2) or requiring approval by client (2.4.1)

Solution 2.4.1 Reduce/avoid cascading contracts

The client could prohibit contractor from using subcontractors, or only allow a limited number (at each level).

Solution 2.4.2 Specific allocation of responsibilities for lower-level contractors

Formal responsibility for lower-level contractors (and their employees) should be allocated clearly between client and the primary contractor.

Solution 2.4.3 Subcontractors must be approved by client

The client can require the contractor only to use subcontractors that are already approved by the client, e.g. based on existing list of approved contractors (solution 1.2.3) or 'certified' by a 3rd party (solution 1.2.2).

Challenges to this solution

The client runs the risk of assuming some of the responsibility for the choice of subcontractors – and share the risk if a subcontractor fails.

3. Organization of work

Different types of dangerous situations occur during execution of contracted work, e.g. when a contractor creates dangerous conditions for those working nearby or after that contractor, when a contractor works with inadequate (safety) equipment or conditions on work site, or when a contractor works unsafely in critical areas.

Such problems arise during *planning* of work, or when *adapting* to changing conditions during execution and thus deviating from – or *adjusting* – the original plan. Planning and adjusting are thus two activities directly related to the actual execution of work – activities that are challenged when work is contracted.

Planning of work – across different areas of expertise

Work must be *planned* to ensure safe sequencing of tasks and timely provision of relevant safety-critical equipment for all work groups involved, and this detailed planning occurs *before* execution, but *after* agreement of contract.

Plans for contracted work involve activities and resources provided by different companies. A client will have to plan the coordination of activities performed by different contractors, e.g. for a construction project. The client may not plan the contractor's work in detail, but take care of a proper – and safe – sequencing of tasks and make sure that contractors have appropriate conditions to perform their work safely, e.g. timely access to shared resources. A contractor will have to plan his own work, taking into account the conditions at the worksite, informing the client (and perhaps other contractors) of the consequences for others and negotiating needs, e.g. in the form of shared resources.

Plans can become unsafe – unsafe sequencing, inadequate equipment and expertise – when the planner has insufficient expertise in other domains or insufficient knowledge about conditions, e.g. a client not knowing the needs of contractors in a project (3.2), or a contractor unfamiliar with risks on the site (3.5).

Adapting to changing conditions – co-ordinating adjustments

When conditions change from those anticipated in the original plan, contractors – or client – may see a need to adapt by making adjustments to the plan. The need for adjustments may reflect changing and unpredictable environments, unstable resources (3.1), inadequate planning or other. Such adjustments will often have affects beyond those making the decisions.

Safety problems arise when such adjustments create dangerous situations for the contractors or for others involved. This can happen when a contractor makes adjustments without considering wider implications, without consulting or even informing others – whether due to inadequate knowledge about conditions and consequences (3.5), not knowing whom to ask for approval (3.4) – and/or simply due to a narrow focus on the individual contractor's own objectives (3.6). Contractors may also behave unsafely in critical areas – due to inadequate knowledge about site, or inadequate information about changes (3.3).

On the other hand, a client may also try to persuade a contractor to perform a task under conditions that the contractor perceive as risky, e.g. to catch up with a deadline.

Problem 3.1 Unstable availability of resources

Execution may depend on safety-critical resources provided by contractors, such as qualified staff and safety equipment.

These resources will often also be used by the contractor for other contracts and other clients. This 'multiple' use of critical resources is an essential element of the contracting 'model' of work, since an independent contractor will be better positioned to profit from investments by making the resources work for different clients instead of using them only occasionally within a single company. Such intensive use of critical resources will require detailed planning by both client and contractor, and these plans will be vulnerable to unforeseen changes, in which cases resources may suddenly no longer be available.

There is also a risk of contractors losing qualified staff that was critical to the contract, which may lead to loss of knowledge for the project or client, and threaten continuity.

In such situations – high demand on, or loss of, qualified staff – a contractor is tempted to use replacements (temporary staff or other) with inadequate qualifications or less familiar with the worksite.

A contractor may also face the opposite situation, having invested in expensive equipment that can only be used for a few similar contracts (See problem 2.1). In this case the contractor may not prioritize investing in proper maintenance, increasing the risk of using equipment in substandard condition.

These problems can be reduced by resource planning (3.1.1), retaining critical knowledge (3.1.2) or limiting the use of temporary staff (3.1.3).

Solution 3.1.1 Long-time planning for critical resources

Long-time planning by client/contractor will allow the contractor to plan for an optimal allocation of qualified labour and critical equipment, and allow both parties to negotiate allocation in good time.

The client may require the contractor to prepare for the risk of loss of critical staff or equipment, and the contractor will require a clear plan from the contractor that guarantees the conditions for timely execution by the contractor.

Solution 3.1.2 Invest in retaining critical knowledge

E.g. by paying fees for critical, highly qualified contractor staff in idle periods.

Solution 3.1.3 Limited proportion of temporary staff

Only allow limited proportion of temporary staff used by contractors.

Problem 3.2 Limitations in expertise

The client will often have limited technical expertise in the tasks carried out by contractors. Even if internal tasks have been outsourced, the client's own expertise will no longer be updated. The client will not know the contractors' needs and find it difficult to plan properly for those task, e.g. by ensuring safe sequencing and preparing relevant safety-critical resources – and will find it difficult to monitor or supervise safely.

This problem can be reduced by including contractors in planning (3.2.1) or hiring external expertise (3.2.2).

Solution 3.2.1 Include contractor knowledge in design and planning

Contractors could participate directly or be included in an adequate process for feedback and adjustments. This may require earlier hiring of contractors. A client could also draw on other contractors not directly involved in the current work, but belonging to a network of contractors (solution 1.2.3).

Solution 3.2.2 Hire external expertise (consultants)

Client or contractor can hire external expertise to assist with planning and designing for safety.

Problem 3.3 Contractors not included in workplace communication

Contractors are often not adequately included in workplace communication and therefore neither adequately updated about changes on the worksite nor likely to inform others about their own adjustments to the original plan – or about observations of critical conditions.

The flow of information may 'dry out' at either end. On the one hand, the client does not inform adequately, or they may provide too much information, perhaps because they do not understand a particular contractor's need for information. On the other hand, a contractor may not 'keep himselv informed', e.g. not be aware of available information if perceived as irrelevant. For instance, a contractor may be unwilling to participate in meetings, especially if spending limited time, and if agendas seem of no relevance to their own work. Such reluctance can also be understood as a legitimate strategy to avoid information overflow in a complex worksite (e.g. a construction site) by focusing resources on a selective approach to communication. They focus on what they perceive as relevant to their execution of their task. However, this selective approach may be too narrow, if they are not aware of the wider implications of their own task.

In other words, the flow of information may dry out when either part is unaware of the proper need for information.

A contractor may also find it difficult to navigate in the balance between formal and informal communication: e.g. a contractor may rely on formal communication and miss vital information that is only – or initially – communicated verbally.

Communication may be further complicated by *adversarial relations* between contractors (based on or reinforced by incentive structures in the contract, Problem 2.2).

These problems can be reduced by a flexible and transparent plan (3.3.1), adequate formal communication (3.3.2) and encouraging informal communication (3.6.1, see later).

Solution 3.3.1 A flexible and transparent plan

Provide a flexible and transparent plan for a project or other forms of interdependent tasks – a plan that emphasizes interfaces and interdependencies between contractors and client. The plan shall increase contractor awareness of their interfaces with others and thus provide a better precondition for adjustments.

The plan should be negotiated and updated according to need.

Solution 3.3.2 Establish adequate formal communication with contractors

Information to contractors about changes (adjustments) relevant to them based on interdependencies defined in the plan. Communication from client should be managed in order to avoid 'information overflow' for contractors with a limited role on a site or a projects – not in order to *hide* 'irrelevant information', but rather to emphasize directly relevant information and leave it to a contractor's discretion to pursue further information.

On the other hand, it should be made clear to contractors whom to contact for consultation/approval of adjustments, e.g. to contact other contractors about how an adjustment may interfere with their plans.

Formal communication also include regular meetings with safety on the agenda and participation from contractors. Participation may be specified in contract – both to emphasize the importance of meetings, and to prepare contractors for the necessary 'cost' (time spent on meeting rather than work) represented by meetings.

Problem 3.4 Unclear responsibility for adjustments

Coordination of adjustments is complicated by unclear responsibility for interdependent tasks. If contractors do not know who to ask for consultation or approval of adjustments/improvisations or find it difficult to contact such persons or get a response in time, they are more likely to go ahead with their own solutions.

Solution 3.4.1 Safety monitoring with feedback

Client should monitor safety performance by contractors, possibly by providing a full-time safety representative on site. Besides questioning unsafe practices and providing feedback between client and contractors about incidents (e.g. by summarizing lessons learned), the safety representative should also be available for questions and assist contractors in finding safe alternatives when coping with unanticipated situations.

The safety representative may be neutral with enough independence from the client to remain perceptive to critical questions from contractors.

Challenges to this solution

The client has no direct employer authority over contractor employees and may find it difficult to correct unsafe practices, other than expelling them from the site. A more productive, but also more time-consuming approach may be to discuss and negotiate corrections with contractor employees, which will also emphasize the safety representative's role as consultant.

Problem 3.5 Contractors with limited knowledge of worksite and overall process

Contractors work on a site that they do not know very well and may not be aware of potential dangers when planning and carrying out their own work. This problem becomes even more critical when they are asked to work on short notice and with limited time for preparation.

They will also have limited knowledge of the overall process, e.g. in a large project, and thus unaware of wider consequence implications for others, e.g. for client or other contractors, if they consider adjustments or improvisations. They thus have no continuous safety awareness (both because of their temporary role, and because of inadequate communication).

These problems can be countered by giving contractors introduction to the worksite (3.5.1), allow adequate time for preparation (3.5.2), and by using a transparent plan (3.3.1, see earlier).

Solution 3.5.1 Introduction to worksite

Client should give contractors adequate introduction to the worksite, both for managers in support of planning, and for on-site workers.

Solution 3.5.2 Adequate time for preparation

Contractors need adequate time for safe preparation, even for short-term jobs, and especially if they are new.

Problem 3.6 Opportunistic contractors

Contractors are not merely *unaware* of wider consequences, but also 'unconcerned'. While a client may perceive this as 'irresponsible behaviour', it also reflects their economic role. They may only work at the site for a short period, and their payment depends strongly on their own performance. Especially when under time pressure they will focus on their own priorities and be unwilling to make an effort for others – and may be tempted to shortcuts or improvisations with little concern for their effect on others. If they cannot expect future contracts, they will have little concern for their reputation.

Solution 3.6.1 Encourage informal communication

Besides formal communication (3.3.2) the client should also improve informal communication with and between contractors, possibly by supporting and encouraging social relations. Informal communication may be better for everyday sharing of complex knowledge, while encouraging continuous safety awareness and responsibility.

Challenges to this solution

This solution may seem costly and with uncertain effects.

4. Small companies

Small companies have limited resources and tend to have a shorter life-span, which in turn may lead to less attention to unlikely risks; and hence, small companies tend to make relatively few dedicated safety investments. Besides increased challenges with unstable resources (3.1, see earlier), small companies also have a social structure incompatible with the traditional formal characteristics of safety management (4.1) and are less exposed to regulation by authorities.

Problem 4.1 Social structure incompatible with formal safety management

Small companies often have a less formal structure than their clients and they depend more on social relationships between employer and employees. Their social structure may thus be incompatible with the formal safety management structure of larger companies (and authorities). This may be a problem during a contract as well as in preparation of bids.

This problem can be reduced by clients assisting small companies (4.1.1) and adapting communication to their needs (4.1.2)

Solution 4.1.1 Assist small companies

Clients should provide extra help for small companies to enable compliance with safety regulations, e.g. safety planning and documentation of safety management systems, compensating for their lack of management as well as lack of resources for dedicated safety measures. This will also help small companies in preparing bids requiring extensive documentation of safety measures (e.g. solution 1.1.1).

Solution 4.1.2 Adapt communication to small companies

Adapt communication to small companies with informal structure, e.g. by taking care to include them in informal communication. This may also be regarded as a special case of solution 3.6.1.

Problem 4.2 Inadequate regulation

Small companies also constitute challenges to regulation, since they are difficult to reach (due to limited resources for inspection), more evasive, and (as already mentioned) uncomfortable with formal regulative requirements. Thus, the client cannot rely on authorities to control their compliance with safety regulations.

Solution 4.2.1 Better monitoring

Enable better monitoring of small companies – with both penalties *and* rewards. This can be regarded as a special case of solution 3.4.1 (safety monitoring), since small companies may require more direct monitoring by the client, to compensate for inadequate regulatory oversight. And use of penalties and rewards correspond to solution 2.2.2, using incentives based on safety indicators. It may also be useful to establish monitoring by Third party 'between contracts' (compare solution 1.2.2).

5. Contractor staff

Client may lose control over labor competences. Contractor employees will often lack site-specific knowledge (5.2) and may have inadequate HSE skills/training (5.1).

Contractor employees will often work excessive work hours – difficult for client to control.

Problem 5.1 Inadequate safety qualifications

Solution 5.1.1 Safety included in competence management

Integrate safety in competence management (permits, occupational licensing) system for contractor employees. Violations should be met with firm reaction, yet the system should be flexible and simple in order to match contractor needs and avoid violations due to inflexible conditions.

Problem 5.2 Lack site-specific knowledge

Contractor employees are not aware of specific risks and requirements related to the work site.

This problem can be reduced by an introduction to the work site (3.5.1, see earlier) that is also adapted to the needs of workers performing daily tasks on the site.

EU Project iNTeg-Risk: EARLY RECOGNITION, MONITORING AND INTEGRATED MANAGEMENT OF EMERGING, NEW TECHNOLOGY RELATED RISKS

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